

Prevalence of food allergy and associated risk factors among children in eastern region, Saudi Arabia

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ABSTRACT

Background: Food allergy is an adverse immune-mediated reaction after exposure to certain types of food. Food allergy is considered a major public health issue worldwide. Therefore, parents with an allergic child are responsible for the management of their children based on their knowledge toward food allergy. This study aims to estimate the prevalence of food allergy and associated risk factors among children in Eastern region, Saudi Arabia. **Methods:** An observational cross-sectional study was conducted among 1522 caregivers in Eastern region, Saudi Arabia from May to July 2021. Data was collected through a self-administrated questionnaire which was distributed online. The data were analyzed using Statistical Package for Social Science version 25. **Results:** A total of 1522 primary caregivers who fulfilled the inclusion criteria. Out of 1522, 524 (34.4%) caregivers stated that their children have a food allergy. Near half of the allergic children, 43.7% were diagnosed by a pediatrician while 29.6% of them underwent medical investigation. The most common food causing allergy was fish (26.2%), followed by Peanuts (19.6%). Preterm, parental and family history of food allergy or atopic diseases showed significant relationships ($p=0.001$) for developing food allergy. **Conclusion:** Our results show that food allergy is a common health problem in Eastern region, Saudi Arabia. The food allergy is not only confined to the child, but it also affects the whole families' well-being. So, a health education program about food allergy is recommended to educate caregivers about food allergies and its management.

Keywords: food allergy, atopic disease, prevalence, immune response, Saudi Arabia



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1. INTRODUCTION

Food allergy (FA), asthma, eczema, and allergic rhinitis are examples of allergic diseases that cause a hypersensitivity reaction to a specific allergen (Bird et al., 2015; António et al., 2017; Alruwaili et al., 2021). Children and adults can both suffer from allergic diseases, and it affects their quality of life negatively (Mahdavinia, 2020). Recent literature has shown that children up to fifteen years old are more likely to have an allergic disease (Mahmoud et al., 2020; Zewde, 2020). Recent studies have shown that the prevalence is much higher in children than in adults, and fortunately, a large number of this allergy in the children resolves as they grow up. However, in some cases, food allergy could remain lifelong (Sampson, 2004). Food allergy is increasing worldwide nowadays causing serious health issues affecting the economy of the health care system (Asher et al., 2006; Sicherer et al., 2001; Patel et al., 2017). The global prevalence of food allergy is 6%-13% (Sampath et al., 2020). The exact prevalence of food allergy in Saudi Arabia is not reported (Gomaa et al., 2020; Alanazi et al., 2017). Self-reported prevalence is usually higher than physician-diagnosed prevalence, as many adverse food reactions, such as food intolerances, food poisoning, and enzyme deficiencies, are misdiagnosed as allergies (Alanazi et al., 2017).

The child could experience a group of symptoms after exposure to food, could be skin changes like rashes, hives, and might reach up to anaphylactic shock which requires immediate intervention (Gupta et al., 2011; Bayomy et al., 2020). Anaphylactic shocks in children are most common due to food allergic reactions (Bohlke et al., 2004). The top eight allergic foods are eggs, milk, peanuts, wheat, crustacean shellfish, tree nuts, soy, and fish (Seth et al., 2020). Children are at risk to have a food allergy if there is family history of allergic diseases (Koplin et al., 2013; Lack, 2012). The causes of food allergies are multifactorial, including genetic, environmental, and nutritional factors. According to nutritional factors, breastfeeding can prevent food allergy but also could be a risk to develop the allergy (Grimshaw et al., 2009; Matheson et al., 2012; Bayomy et al., 2020). As any disease diagnosing food allergy need full medical history, physical examination and specific investigation including IgE antibodies and supervised oral food challenges. However oral food challenge is the gold standard method to diagnose a food allergy (Nowak-Wegrzyn et al., 2009) knowing the modifiable risk factors essential in preventing or decreasing the risk of the prevalence (du Toit et al., 2016; Roduit et al., 2014).

Recent literature has shown some of these risk factors, including maternal diet during pregnancy and the breastfeeding period. Another risk is including the time of introducing food to the infant (Muraro et al., 2004). The latest recommendations state that the age of 4-6 months is the best time to introduce the allergenic foods to the diet, as it is effective in decreasing the risk of developing food allergy (Sicherer et al., 2017; Togias et al., 2017). The best management of food allergy is avoidance of the causes of allergens. Most parents complain about the difficulties to avoid food-induced allergens since they are present in the meals such as milk and eggs (Bock et al., 2001). Families, teachers, and parents have a significant role in managing a child who has food allergies. Therefore, they should have sufficient knowledge of their child's situation and how to handle the allergy reaction (Gupta et al., 2008).

To our knowledge and based on the literature review, there are scanty literatures about the prevalence of FA in Saudi Arabia (Gomaa et al., 2020; Alanazi et al., 2017) and no similar studies conducted to shed light on this issue in the eastern province in Saudi Arabia. Therefore, this study aimed to estimate the prevalence of FA among children and its associated risk factors and to assess maternal awareness, knowledge, and practice about the time of introducing potentially allergenic foods into children's diet.

2. MATERIAL AND METHODOLOGY

Aims

This study aims to estimate the prevalence of FA among children and associated risk factors in eastern region, Saudi Arabia & assessment of parental awareness, knowledge, and practice regarding the timing of introducing potentially allergenic foods

Study Design and Participants

This was an observational, cross-sectional study conducted among 1522 caregivers in eastern region, Saudi Arabia from May to July 2021 to explore the prevalence of FA among children and its associated risk factors. The inclusion criteria were, all of the primary caregivers having children between the ages of 6 months to 15 years and living in Eastern region, Saudi Arabia. The exclusion criteria were caregivers having children <6 months of age or more than 15 years and not living in Eastern region were excluded.

Data Collection Instrument and Procedures

Self-administered questionnaire composed of 4 parts: the first part is about the biographical data of the caregivers. The second part is specific for who have a child with food allergy that documenting the most type of food causing allergy, diagnosis and treatment. The third part is about associated risk factors like mode of delivery, gestational age, and mode of feeding, the family history of food

allergy or atopy. The fourth part is about parental perception and time of introducing allergic food. This questionnaire was distributed online through social media. A pilot test conducted on 20 participants that selected randomly to assess the clarity of questions and its applicability.

Data analysis

The data were coded, and entered into statistical software IBM SPSS version 25 (SPSS, Inc. Chicago, IL). Two tailed tests were used for all statistical analysis. P value less than 0.05 considered as statistically significant. For knowledge and perception items, scored one point for a correct answer and summation of separated scores were calculated. A participant with score less than 60% considered to have poor knowledge level while good knowledge level was considered if he/she had score of equal or more than 60%. Descriptive analysis was used for all variables. Cross tabulation was used to assess distribution of allergy history by different determinants and parents' practice regarding food introduction timing and developing of food allergy among children. Relations were tested using Pearson chi-square test.

3. RESULTS

A total of 1522 primary caregivers for children who fulfilled the inclusion criteria completed the study questionnaire. The range of mother's ages was from 18 to 54 years with a mean age of 34.6 ± 11.9 years old. As for the father's ages, it ranged from 19 to 59 years with a mean age of 37.9 ± 12.2 years old. The exact of 70.4% of children mothers were university graduated and also 67.5% of their fathers. Monthly income less than 5000 SR was reported among 16.3% of caregivers and 39% reported 5000-9000 SR monthly income (Table 1).

Table 1 Sociodemographic data of the participants, Eastern region, Saudi Arabia

Parent personal data	No	%
	1522	100
Age of the mother (years)		
< 25	253	16.6%
25-34	456	30.0%
35-45	582	38.2%
> 45	231	15.2%
Age of the father (years)		
< 25	30	2.0%
25-34	408	26.8%
35-45	585	38.4%
> 45	499	32.8%
Mother's education		
<i>Below university</i>	451	29.6%
<i>University</i>	1010	66.4%
<i>Post graduate</i>	61	4.0%
Father's education		
<i>Below university</i>	494	32.5%
<i>University</i>	935	61.4%
<i>Post graduate</i>	93	6.1%
Family income		
< 5000 SR	248	16.3%
5000-9000 SR	594	39.0%
10000-20000 SR	531	34.9%
> 20000 SR	149	9.8%

Table 2 illustrates the prevalence of FA and its pattern. An exact of 524 (34.4%) children in the eastern region had food allergy. Food allergy was diagnosed by pediatrician among 43.7% of the children while 44.3% were diagnosed by parents' experience. Blood

or skin tests were done among 29.6% of the children with food allergy. The exact of 335 (63.9%) children with food allergy know about their disease and medications were used among 50.4% of them.

Table 2 Prevalence of food allergy and its pattern among children in eastern region, Saudi Arabia

Food allergy data	No	%
Child has food allergy		
Yes	524	34.4%
No	998	65.6%
Who diagnosed child with Food allergy?(n=524)		
Pediatrician	229	43.7%
General practitioner	63	12.0%
None	232	44.3%
Was blood or skin tests done to determine the cause of food allergy? (n=524)		
Yes	155	29.6%
No	369	70.4%
Was blood or skin tests done to determine the cause of food allergy? (n=524)		
Yes	155	29.6%
No	369	70.4%
Does your child know that he/she has food allergy? (n=524)		
Yes	335	63.9%
No	189	36.1%
Have you been used any medications to treat food allergy? (n=524)		
Yes	264	50.4%
No	260	49.6%

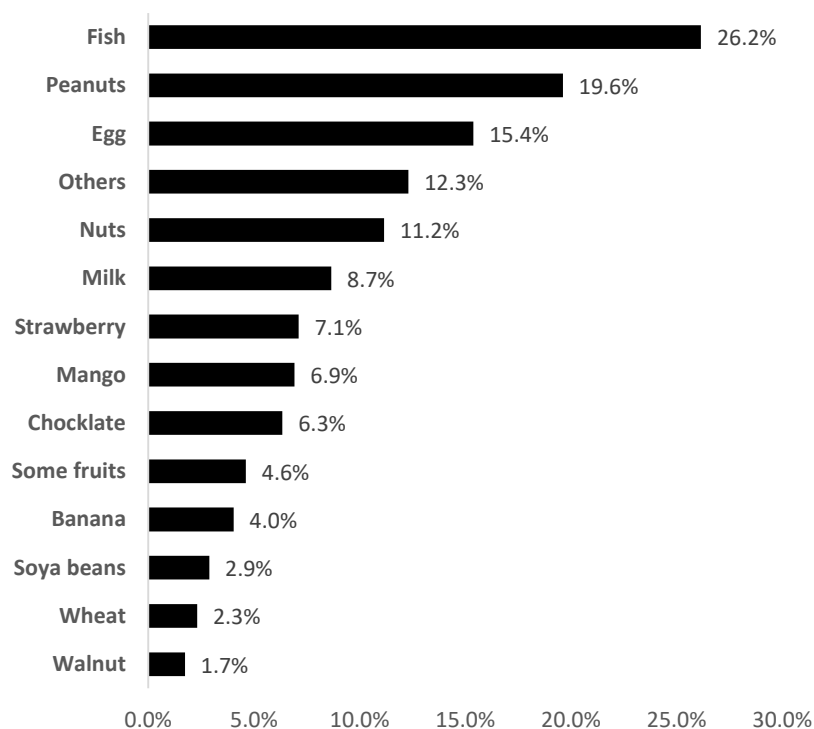


Figure 1 Foods associated with food allergy among children in Eastern region, Saudi Arabia

Figure 1 show foods associated with food allergy. The most-reported foods causing food allergy were fish (26.2%), followed by Peanuts (19.6%), egg (15.4%), nuts (11.2%), milk (8.7%), and strawberry (7.1%). The least reported foods were soya beans (2.9%), wheat (2.3%), and walnut (1.7%). Table 3 demonstrates associated risk factors of developing food allergy. The exact 85.7% of children with pregnancy duration less than 7 months had food allergy in comparison to 30.6% of those who had full pregnancy time (9 months or more) with recorded statistical significance ($P=.001$). Also, 61.3% of children who suffer from any atopic diseases developed food allergy compared to 26.4% of those who did not ($P=.001$). The exact 63.7% of children with their mothers complaining of food allergy had developed the diseases compared to 62.9% of children with both parents and 28% of others with free parents ($P=.001$). Also, 43.3% of children had family history of atopic diseases suffer from food allergy in comparison to 29.6% of others ($P=.001$). Besides, 63.1% of children with their siblings did any of the child's siblings have a food allergy during childhood suffer from food allergy compared to 27.7% of those with free siblings ($P=.001$).

Table 3 Associated risk factors of developing food allergy among children in Eastern region, Saudi Arabia

Determinants of food allergy	Child had food allergy				p-value
	Yes		No		
	No	%	No	%	
Mode of delivery					
Normal vaginal delivery	410	33.6%	811	66.4%	.160
Caesarean section	114	37.9%	187	62.1%	
Duration of the pregnancy					
< 7 months	12	85.7%	2	14.3%	.001*
7-8 months	39	40.6%	57	59.4%	
9 months	440	33.7%	864	66.3%	
> 9 months	33	30.6%	75	69.4%	
Type of feeding					
Breast feeding	133	31.9%	284	68.1%	.327
Formula feeding	108	37.2%	182	62.8%	
Both	283	34.7%	532	65.3%	
Duration of feeding					
< 4 months	69	40.6%	101	59.4%	.192
4 months - 1 year	127	33.1%	257	66.9%	
> 1 year	328	33.9%	640	66.1%	
Does the child suffer from any atopic diseases?					
Yes	215	61.3%	136	38.7%	.001*
No	309	26.4%	862	73.6%	
Parental history of food allergy?					
Father	67	55.8%	53	44.2%	.001*
Mother	93	63.7%	53	36.3%	
Both	22	62.9%	13	37.1%	
None	342	28.0%	879	72.0%	
Family history of atopic disease?					
Yes	232	43.3%	304	56.7%	.001*
No	292	29.6%	694	70.4%	
Did any of the child's siblings					.001*

have a food allergy during childhood?				
Yes	169	63.1%	99	36.9%
No	274	27.7%	715	72.3%

P: Pearson X^2 test

* $P < 0.05$ (significant)

Table 4 reveals parent's knowledge and perception regarding food allergy. The exact 73.5% of study parents know that skin rash, swelling of the face, difficulty breathing, nausea and vomiting, abdominal pain are the most common manifestation of food allergy. Also, 69.4% think that allergic diseases are transmitted in the family, 64.9% think the best way to prevent food allergy is to stay away from food, 67.1% think it is not easy to wean a child away from food allergens, and 64.9% reported that the best way to prevent food allergy is to stay away from food. As for the school role, 82.8% of the parents told that schools should have plans to keep children with food allergies safe at school. Regarding preventing food allergy, 54.3% of the parents think that changing the time of introducing allergenic foods to the child, whether by accelerating or delaying while 67.1% think that it is not easy to wean a child away from food allergens. In total, 668 (43.9%) parents had good knowledge and perception level regarding food allergy among children.

Table 4 Parent's knowledge and perception regarding food allergy in eastern region, Saudi Arabia

Parent's knowledge and perception regarding food allergy	Yes		No		Don't know	
	No	%	No	%	No	%
Do you think that skin rash, swelling of the face, difficulty breathing, nausea and vomiting, abdominal pain the most common manifestation of food allergy?	1119	73.5%	174	11.4%	229	15.0%
Do you think that allergic diseases are transmitted in the families?	1056	69.4%	261	17.1%	205	13.5%
Do you think food allergies are more common in children than adults?	962	63.2%	288	18.9%	272	17.9%
Do you think taking medication every day can prevent food allergy?	276	18.1%	757	49.7%	489	32.1%
Do you think that food allergy causes death?	494	32.5%	631	41.5%	397	26.1%
Do you think the best way to prevent food allergy is avoid allergic food?	988	64.9%	403	26.5%	131	8.6%
Do you think allergic children receive more care and attention from their parents?	1104	72.5%	257	16.9%	161	10.6%
Do you think parents worry a lot about their children with allergy?	1184	77.8%	232	15.2%	106	7.0%
Do you think that it is not easy to wean a child away from allergic food?	1021	67.1%	405	26.6%	96	6.3%
Do you think schools should have plans to keep children with food allergies safe at school?	1260	82.8%	151	9.9%	111	7.3%
Do you think changing the time of introducing allergenic foods to the child, whether by accelerating or delaying might help in prevention of	827	54.3%	305	20.0%	390	25.6%

food allergy?						
Has your child's doctor advised you to speed up the introduction of foods that may trigger allergies	350	23.0%	862	56.6%	310	20.4%
Overall knowledge level	Poor (854; 56.1%)		Good (668; 43.9%)			

Table 5 clarifies the distribution of mother's practice regarding the timing of introducing potentially allergenic foods according to child food allergy status. Exact of 53.2% of children with FA had food by their parents at the age of 4 to 6 months compared to 67.4% of those without while 39.3% of children with FA had the food after the age of 6 months compared to 26.6% of others (P=.001). The exact 81.8% of the caregivers introduced eggs to their children after the age of 6 months (81.3% for children with FA vs. 82.1% of others; P=.934). Peanuts were introduced to 93.2% of the study children after they completed 6 months of age (91.4% of children with FA vs. 94.1% of others; p=.145). Also, seafood was introduced to the children by 89.8% of caregivers after they completed 6 months of age (87.8% of FA children vs. 90.8%). Exact of 93.9% of the study children caregivers introduced nuts after the age of 6 months (92.9% for FA children compared to 94.4% of others; p=.045). Also, wheat was introduced at the age of 4-6 months among 50.9% of children caregivers (40.3% for FA vs. 56.5% for others; p=.001).

Table 5 Distribution of mothers practice regarding timing of introducing potentially allergenic foods according to child food allergy status

Food introduction practice	Total		Child had food allergy				p-value
			Yes		No		
	No	%	No	%	No	%	
Age of introducing food to your child?							
<i>Before 4 months</i>	99	6.5%	39	7.4%	60	6.0%	.001*
<i>At 4-6 months</i>	952	62.5%	279	53.2%	673	67.4%	
<i>After 6 months</i>	471	30.9%	206	39.3%	265	26.6%	
Age of introducing egg to your child?							
<i>Before 4 months</i>	28	1.8%	10	1.9%	18	1.8%	.934
<i>At 4-6 months</i>	249	16.4%	88	16.8%	161	16.1%	
<i>After 6 months</i>	1245	81.8%	426	81.3%	819	82.1%	
Age of introducing Peanuts to your child							
<i>Before 4 months</i>	30	2.0%	13	2.5%	17	1.7%	.145
<i>At 4-6 months</i>	74	4.9%	32	6.1%	42	4.2%	
<i>After 6 months</i>	1418	93.2%	479	91.4%	939	94.1%	
Age of introducing fish and sea food to your child?							
<i>Before 4 months</i>	30	2.0%	11	2.1%	19	1.9%	.160
<i>At 4-6 months</i>	126	8.3%	53	10.1%	73	7.3%	
<i>After 6 months</i>	1366	89.8%	460	87.8%	906	90.8%	

Age of introducing nuts to your child							.045*
Before 4 months	33	2.2%	18	3.4%	15	1.5%	
At 4-6 months	60	3.9%	19	3.6%	41	4.1%	
After 6 months	1429	93.9%	487	92.9%	942	94.4%	
Age of introducing wheat to your child							.001*
Before 4 months	100	6.6%	34	6.5%	66	6.6%	
At 4-6 months	775	50.9%	211	40.3%	564	56.5%	
After 6 months	647	42.5%	279	53.2%	368	36.9%	

P: Pearson χ^2 test

* $P < 0.05$ (significant)

Figure 2 shows the source of parents' information regarding FA. The most-reported parents' source of information was social media (53.9%), followed by health care workers (47.6%), family and friends (46.7%), posters (39.2%), and books (39%).

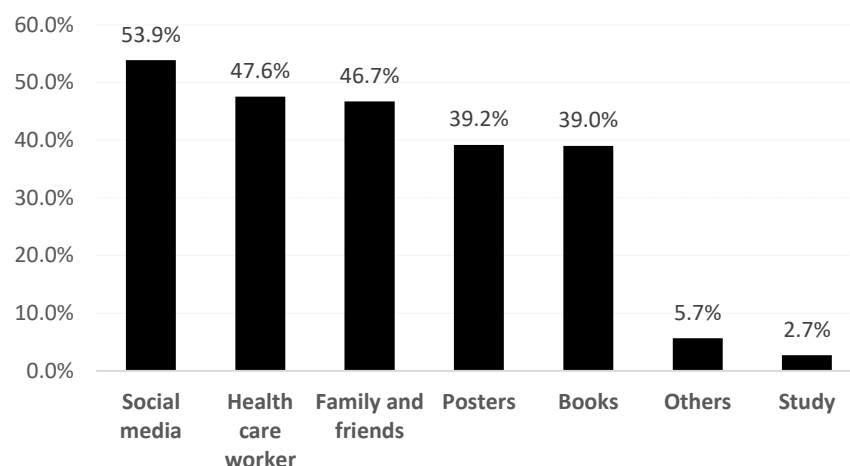


Figure 2 Source of parents' information regarding food allergy among children in eastern region, Saudi Arabia

4. DISCUSSION

The current study was conducted mainly to estimate the prevalence of FA among children and associated risk factors in eastern province of Saudi Arabia. Other objectives included the assessment of parental awareness, knowledge, and practice regarding the timing of introducing potentially allergenic foods also, to measure the relationship between sociodemographic and perception of FA. FA is an irregular response of the body to some types of food. Food allergy is different than food intolerance although they may share the same symptoms (Renz et al., 2018; Muthukumar et al., 2020). For children, food allergy is considered a considerable health topic that can be life-threatening. The frequency of food allergy, mainly to peanuts, may be increasing among children (Grundy et al., 2002; Sicherer & Sampson, 2006; Sicherer et al., 2007; Sebastien & Ben-Shoshan, 2019).

The current study showed that about one-third of the children had food allergy reference to their parent report. The child with food allergy was diagnosed mainly by a pediatrician but only 29% of those children undergone confirmatory laboratory or skin tests. Also, only half of the children received drugs for food allergy. This estimated prevalence was higher than what was reported by (Lyons et al., 2020) who reported that the prevalence of self-reported food allergy ranged in Europe from 6.5% in Athens to 24.6% in Lodz. Also, the prevalence of FA ranged from 1.9% in Reykjavik to 5.6% in Lodz. In the United States, (Branum & Lukacs, 2009) was found that 3.9% of US children less than 18 years developed food allergy. The incidence of FA increased to 18% from 1997 through 2007 which is still lower than the current study estimated prevalence. Also, (Peters, 2017) estimated much lower rates of food allergy among children. Authors reported that the prevalence of confirmed FA at 1st year of age and 4 years were 11.0% and

3.8%, respectively. In Saudi Arabia, (Althumiri et al., 2021) assessed the prevalence of FA among adults by 19.7%. A similar finding to the current study was assessed by (Gomaa et al., 2020) who estimated that 30% of Taif mothers reported that their children had food allergy. Only 12% of those allergic children were diagnosed with food allergies through medical investigations.

Regarding food-inducing allergy, fish, peanuts, egg, nuts, and milk were the most reported by the current study. These reported allergic foods are consistent with other literature studies which reported peanuts, egg, and milk as the main allergens among children (Lyons et al., 2019; Iweala et al., 2018; Kim et al., 2017; Alsharairi, 2019) preterm labor, having other atopic diseases, parental and family history of food allergy were the significant predictors for food allergy among children. As for parental awareness, knowledge, and practice regarding the timing of introducing potentially allergenic foods, the current study showed that less than half (44%) of the mothers had good knowledge and perception level. The highest awareness was for the clinical presentation of food allergy, the parents worry and concern regarding food allergy, the familial transmission of food allergy, and the school role to keep allergic children safe.

Considering the timing of introducing potentially allergenic foods, the study results showed that, the mothers introduced these types of foods after the age of 6 months, especially for peanuts, nuts, fish, and seafood. About two-thirds of the mothers introduced food in general to their children during the age period of 4-6 months. These findings were in a match with (Almutairi et al., 2021) who found that most Saudi mothers introduced allergic food for their children at 9.8 ± 3.2 months for eggs, 14.6 ± 5.78 months for peanuts, and 13.6 ± 5.37 months for fish. Also, (Gomaa et al., 2020) reported that 58% of their study mothers had poor knowledge about food allergy which is consistent with the current study estimated level. On the other hand, (Alotaibi et al., 2020) revealed that Saudi parent's awareness of food allergy was poor but there was still an optimal need to deal with the disease condition correctly.

5. CONCLUSION

This study and previous studies are highlighting the increasing number of food allergies among children in which make it a public health issue. As the number of affected children increased, caregivers will face the burden of risk assessment and management. Treatment and diagnostic methods are essential to avoid the exclusion of the diets and to make a personalized diet chart. Thereby, a health education program is recommended to raise awareness and correct misconceptions about food allergies and its management options because caregivers should have good knowledge and perception. Having appropriate knowledge about food allergy is a cornerstone for prevention of adverse reaction. Further study is needed for assessment of changes in parental knowledge and perceptions following the introduction of support services. Moreover, future researches in the same field are recommended in different areas of Saudi Arabia.

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Author contribution

All authors of this study were equally involved in the design of the study, data collection, analysis, drafting and correction of the final draft, and the author was responsible for the proper implementation of the study at all stages. There is no author whose name is not listed in the authors list.

Informed consent

Written & Oral informed consent was obtained from all individual participants included in the study. Additional informed consent was obtained from all individual participants for whom identifying information is included in this manuscript.

Ethical approval for study protocol /study design /Methodology

The study was approved by the Medical Ethics Committee of Research Center, Almoosa Specialist Hospital (ethical approval code: ACR-21.08.03)

Abbreviation and Acronyms

FA: food allergy

Conflicts of interest

The authors declare that they have no conflict of interest.

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This study has not received any external funding.

Data and materials availability

All data associated with this study are present in the paper.

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